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ABSTRACT

Students need a variety of ways to encourage them to learn. Web-based learning can provide a platform for achieving this in a variety of ways other than the simple provision of "flat" lecture notes. This paper describes a number of Web-based programs used to augment, rather than replace, traditional, face-to-face delivery of a pharmaceutical microbiology module to second year undergraduates on a 4-year "MPharm" course. The paper reports feedback from three cohorts of students. Experience of delivering this module over three academic sessions suggests that using Web-based learning to augment traditional face-to-face teaching was successful, both for the tutor and for the students. The Web site was well used, and student performance in and commitment to the module was enhanced, as judged by the feedback questionnaires, attendance at classes and by achievement in assessments. It was clear from the student behavior that, like many tutors, students find it difficult to shed the "hard copy habit," and feel the need to print out most of the Web pages. This has implications for the support provided for them to do this. The amount of Web-based learning that is expected of students needs to be carefully judged to avoid "screen fatigue" among them. (AEF)

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Web-based Strategies for Improving Undergraduate Commitment to Learning

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Abstract: Students need a variety of ways to encourage them to learn. Web-based learning can provide a platform for achieving this in a variety of ways, other than the simple provision of "flat" lecture notes. This paper describes a range of strategies used in a module to encourage on-campus, full-time undergraduates to learn and presents feedback on this approach from three cohorts of students. It represents the use of the Web to augment traditional face-to-face teaching rather than to replace it.

Introduction

Web-based learning is ideal for learners studying at a distance but also offers a range of learning opportunities for full-time, on-campus undergraduates (Ryan et al. 2000), many of whom may need help to increase their commitment to learning. A number of factors are driving the use of web-based learning in undergraduate curricula, including:

- the rising expectations of students to use this technology in their learning;
- the benefits that this form of delivery offers in providing an "always on" source of interactive learning that is easy for the tutor to keep current;
- the need to teach larger groups of students;
- the need to offer learning flexibility to the increasing number of full-time students with part-time jobs;
- the need to compete with other providers of higher education that are not necessarily traditional on-campus universities;
- the use of this new technology being implicit in the Dearing Report (Dearing, 1997);
- university strategic plans for learning and teaching where the adoption of this technology is explicit.

This paper describes a number of web-based programs produced by the author which he uses to augment, rather than to replace, traditional face-to-face delivery of a pharmaceutical microbiology module to second year undergraduates on a 4-year MPharm course. It also reports students' feedback and attainment after using these programs.

Microbiology Practical Tutor

Students are required to work through a web-based practical tutor (Fig. 1) before coming to each laboratory class. Each laboratory session has its own set of web pages which explain, using high-quality images, the tasks to be undertaken in the class. Questions are posed about the underlying principles behind the techniques and links are offered to sites on the World Wide Web, such as the UK Public Health Laboratory Service site. In this way, students arrive for the class better prepared, the introductory talk session in reduced and the exercises are completed more efficiently. In addition, the students gain experience of using a range of resources on the Internet and are able to place their learning of practical skills into a practice context. To ensure that this web-based preparatory work has been undertaken, an open-book spot test is given at the beginning of each class, which contributes towards the students' coursework assessment. This web tutor also provides examples of positive and negative results that can be expected in the experiments so that students know beforehand what to look for when they return to the laboratory in a subsequent class to read their results.

BEST COPY AVAILABLE

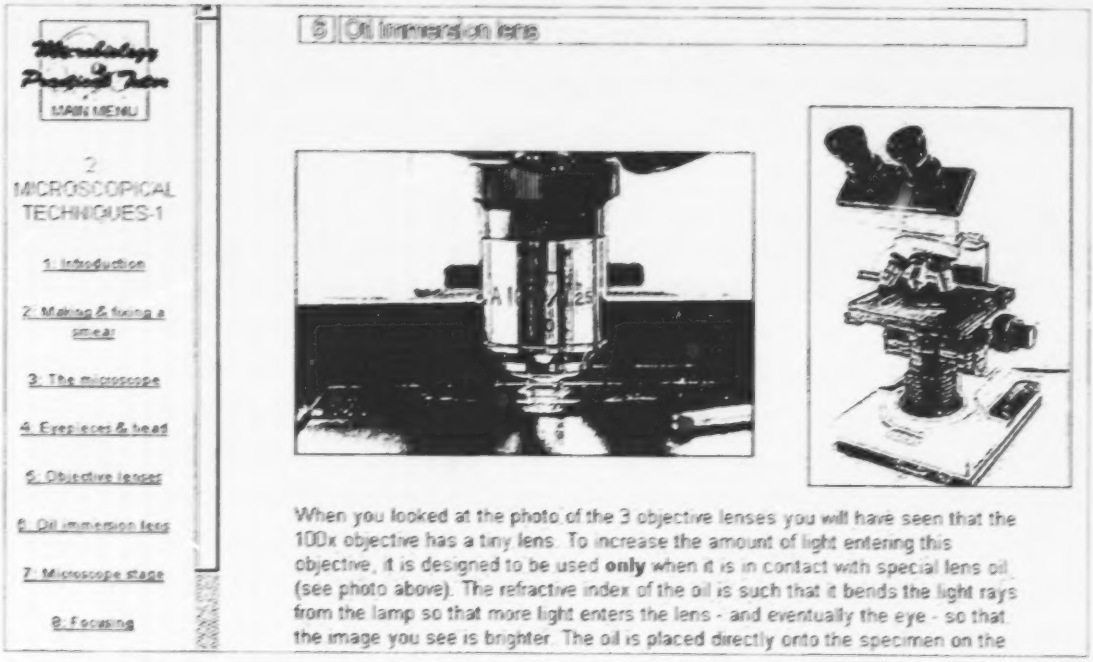
MAIN MENU
2
MICROSCOPICAL TECHNIQUES-1
1: Introduction
2: Making & fixing a smear
3: The microscope
4: Eyepieces & head
5: Objective lenses
6: Oil immersion lens
7: Microscope stage
8: Focusing
5 Oil immersion lens
When you looked at the photo of the 3 objective lenses you will have seen that the 100x objective has a tiny lens. To increase the amount of light entering this objective, it is designed to be used only when it is in contact with special lens oil (see photo above). The refractive index of the oil is such that it bends the light rays from the lamp so that more light enters the lens - and eventually the eye - so that the image you see is brighter. The oil is placed directly onto the specimen on the

Figure 1: A web page from the *Microbiology Practical Tutor*

DE MONTFORT UNIVERSITY LEICESTER
PhBrSite home
PHAR2404: Microbiological Calculations
Instructions:
Click in the top box and type in your answer (including units where necessary) then click DONE.
Click HELP if you want a hint for the solution.
Your running score is:
6 out of 9
Question 9 (of 10)
If 100mg of an antibiotic powder has a displacement volume of 0.35mL, how much water for injections would have to be added to 200mg of powder to make an injection with a final volume of 10mL?
Click in this box and type in your answer 9.3mL
DONE
HELP
NEXT QUESTION
Your answer is correct.
This problem concerns the preparation of injections, where you have to take into account the displacement volume of powders in order to add the correct volume of diluent to achieve the required concentration of the drug in a specified
Site created and maintained by Dr M. Andrew
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Figure 2: A web page from the *Microbiological Calculations Tutor*

Microbiological Calculations Tutor

The ability to successfully undertake simple calculations is obviously important to prospective pharmacists, who eventually will have to correctly calculate drug doses. Yet, undergraduate students are notoriously bad at calculations. A web-based *Microbiological Calculations Tutor* has been written for them to improve their numeracy (Fig. 2). Students are given three weeks to work through this tutor in their own time and at their own pace before undertaking a time-constrained test without the use of calculators. Each time the test is run, the questions remain the same but the values are changed so students are advised to repeatedly use the package until they become proficient in each type of calculation. A HELP text box is provided for each question, which describes, in simple terms, a method for arriving at the solution. This package has proved popular with students (Tab. 2) and its use has improved their ability to perform the calculations (Fig. 4).

Interactive specimen examination paper

To give practice in answering the end-of-module written examination, an interactive specimen paper is provided, which students work through in their own time. Besides familiarising themselves with the format of the paper, students can attempt to answer the specimen questions provided and receive on-line feedback on their responses (Fig. 3). The second section of the exam paper consists of multiple response questions (MRQs) and a separate web tutor is provided to practise these. The MRQs are fully randomised and provide the opportunity for students to see the impact of the imposed "negative marking" on their performance. Questions are presented 10 at a time and students are encouraged to repeatedly use the tutor until they feel confident to answer the questions correctly. A different bank of questions is used in the real examination paper.

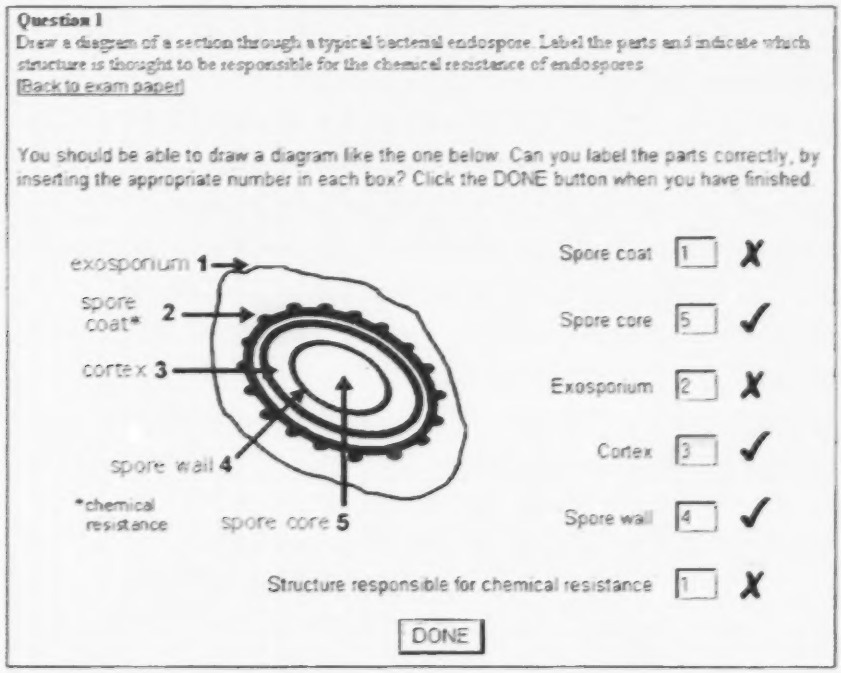
Question 1
Draw a diagram of a section through a typical bacterial endospore. Label the parts and indicate which structure is thought to be responsible for the chemical resistance of endospores
[Back to exam paper]
You should be able to draw a diagram like the one below. Can you label the parts correctly, by inserting the appropriate number in each box? Click the DONE button when you have finished.
exosporium 1
spore coat* 2
cortex 3
spore wall 4
*chemical resistance
spore core 5
Spore coat 1 ✗
Spore core 5 ✓
Exosporium 2 ✗
Cortex 3 ✓
Spore wall 4 ✓
Structure responsible for chemical resistance 1 ✗
DONE

Figure 3: A web page from the interactive specimen examination paper showing the feedback given after the user has completed the question and pressed the DONE button

Feedback on assessment and teaching

Part of good teaching is to provide adequate and timely feedback to students on their assessment. The author uses web pages to do this. Feedback is given in the form of general comments and as histograms of coursework marks and examination performance, so that students can place their own achievement within the context of the whole cohort. The data showing the improvement in performance after using the *Microbiological Calculations Tutor* was published on the module website (Fig. 4) to encourage students to perform as well in similar questions in the end-of-module written examination.

It is equally important to elicit students' views on the delivery of the module, to provide them with an analysis of the results and for the tutor to respond to their comments. This shows students that their comments are valued and also closes the quality loop. The results of all questionnaires completed for the module are published on the website, together with the tutor's responses to the students' comments.

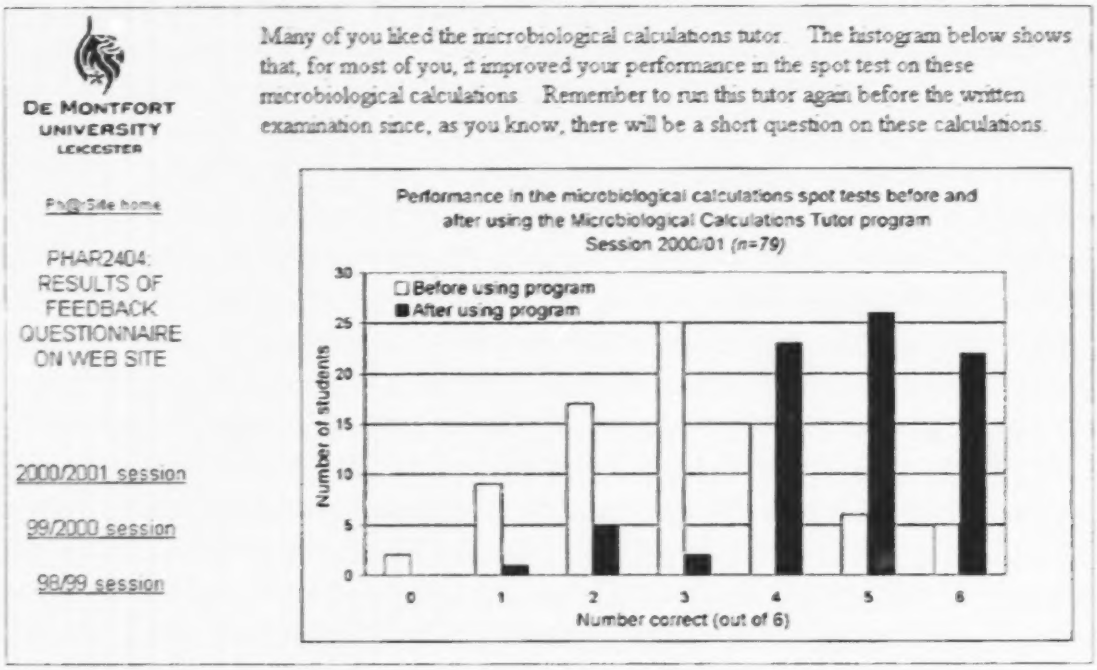
DE MONTFORT UNIVERSITY LEICESTER
Ph@S4e home
PHAR2404: RESULTS OF FEEDBACK QUESTIONNAIRE ON WEB SITE
2000/2001 session
99/2000 session
98/99 session
Many of you liked the microbiological calculations tutor. The histogram below shows that, for most of you, it improved your performance in the spot test on these microbiological calculations. Remember to run this tutor again before the written examination since, as you know, there will be a short question on these calculations.
Performance in the microbiological calculations spot tests before and after using the Microbiological Calculations Tutor program
Session 2000/01 (n=79)
Before using program
After using program
Number of students
0
5
10
15
20
25
30
0
1
2
3
4
5
6
Number correct (out of 6)

Figure 4: A web page summarising student feedback on use of the module website, showing the tutor's feedback returned to students on their calculations assessment

Putting their studies into context

In vocational courses, like Pharmacy, it is desirable to put the course into the context of the profession wherever possible, so that students can see the relevance of their studies and increase their commitment to the course. Students on our MPharm program are provided with *PharmScape*, which is an interactive website describing the profession of pharmacy (Andrew, 1998). It uses, as a contextual device, the story of the development of a drug from its discovery to its delivery to the patient. As the story unfolds, each of the modules in the MPharm program is introduced to show how they fit into the overall picture. Hyperlinks are provided to show the content of each module. Students are encouraged to refer back to this website regularly during their studies to help them relate learning to practice.

Other web pages for the module

Other learning material that is provided as web pages for the students studying this module includes:

- a list of learning resources, including links to the publishers' websites of the recommended textbooks and to on-line bookshops for possible book purchase;
- lecture outlines and the assessment criteria for the module;
- *Dangerous Microbes*, an interactive tutor for learning the names of microbial pathogens and the diseases they cause;
- The lecture presentations (as HTML versions of the author's *PowerPoint* presentations);
- *Microbes in the News*, links to relevant topical articles from UK newspapers and other media.

Student response to the web-based learning for this module

Student opinions of the web-based learning packages for the module were elicited by means of an anonymous questionnaire. Students responded to the statements using a 5-point Likert scale with the options: strongly agree, agree, neutral, disagree, to strongly disagree. Table 1 summarises the results from questionnaires completed by three cohorts of students.

Statements	Percentage of students agreeing/strongly agreeing		
	1998/99	1999/2000	2000/2001
	n=81	*n=89*	*n=79*
A) It enhanced my learning experience	95	86	96
B) It was clear and easy to use	96	95	97
C) It was of the appropriate intellectual standard	89	90	91
D) I liked learning in this way	56	44	64
E) It increased my interest in microbiology	47	44	44
F) It increased my confidence in using computers	63	44	46

Table 1: Summary of an evaluation of the module website completed by three cohorts of students.

The data show that a high proportion of students felt that the web-based material enhanced their learning experience, that it was clear and easy to use and that it was of the appropriate intellectual standard. Some students were less enthusiastic than others to adopt this technology (see statement D; Tab. 1), but this is not an uncommon finding (French et al. 1999). Face-to-face discussion with the students on their questionnaire responses revealed that the low score for statement F was because many of them felt sufficiently confident in the use of computers before undertaking the module (a tribute to a previous module in which this topic was taught). Generally, there is remarkable consistency between the responses of the different student cohorts.

As part of the questionnaire, the students were invited to add written comments if they wished. Over one third of all respondents chose to do so. All comments were positive; Table 2 shows a representative selection of them.

"I found the website very useful and easy to follow. The microbiology practical tutor and the dangerous microbes programs were very good. Study would be a lot easier if all lecturers had a website like this."
""I use the website regularly and find it very helpful. Backs up the lectures and practicals successfully. Increases my confidence for the phar2404 module."
"I think that the website is very good and has been very helpful to me. Also provides extra material to make the practical part of the course feel complete. Very useful."
"Practical tutor helped in practicals a lot."
"The practical tutor was excellent for information about the forthcoming practicals but gaining access to them was sometimes difficult and very time consuming if there was no Internet access at home."
"The website was a different way to aid learning and encouraged more effort to be put in to preparation for the labs."
"Computer program was very useful, especially the microbiological calculations tutor."
"The calculations tutor was very good as the answers were given and explained in a very understandable manner. This was good as many modules expect you to excel in maths and not all of us do."
"The website is an excellent way to receive information. The only problem being that the printers in the computer node are rubbish and therefore taking printouts is difficult."

Table 2: Student comments on the web-based learning material used to deliver the module

Conclusions

Experience of delivering this module over three academic sessions, suggests that using web-based learning to augment traditional face-to-face teaching was successful, both for the tutor and for the students. The website was well used, with some hits even being recorded on Christmas Day on two consecutive years! Student performance in, and commitment to, the module was enhanced, as judged by the feedback questionnaires, attendance at classes and by achievement in assessments. It was clear from the student behaviour that, like many tutors, students find it difficult to shed the "hard copy habit", feeling the need to printout most of the web pages. This has implications for the support provided for them to do this (see last comment; Tab. 2). Moreover, the amount of web-based learning that is expected of students needs to be carefully judged to avoid "screen fatigue" amongst learners.

It is felt that providing web-based material is an ideal way of augmenting learning in the traditional on-campus setting, although it is arguable whether the "sage on the stage" should be *replaced* by the "guide on the side" for this group of learners. Full-time students have a right to expect access to their tutors and, for this reason, the author has not yet provided a chat-room for this module.

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